

25mm Differential with Internal Proximator®

*With today's advanced technology, we
can reduce the size of the Proximator®
and mold it into the 25mm probe tip assembly*

Differential expansion is an important measurement on large steam turbines used for power generation. It is a measurement of the difference between the turbine rotor's axial expansion and the turbine casing's axial expansion. During startup and on-line operation of the turbine, differential expansion should be monitored to avoid contact between rotating and stationary machine components. Such contact is known as *axial rub* and can result in dangerous and expensive machine damage. Monitoring differential expansion can:

- Minimize the possibility of an axial rub
- Help maintain a high degree of turbine thermal efficiency

Advanced transducer for steam turbine environments

In the past, Bently Nevada has offered several types of Extended Range Proximity Transducers which are operating reliably in hundreds of steam turbines worldwide. Recent research and development conducted in our laboratories now allows us to offer a new approach to extended range proximity sensors.

Bently Nevada is pleased to announce our latest transducer designed specifically for steam turbines: The 25mm Differential Expansion Transducer. This

long-range, eddy current proximity sensor has the following benefits:

- Integral Probe/Proximator® design provides *maximum durability* using advanced, in-probe electronics that requires no interfaces between the probe and monitor
- Innovative, built-in Proximator® offers major improvements in signal accuracy and temperature stability
- 100% Relative Humidity Rating (non-submerged) for high reliability in moist turbine environments
- 100 PSI (7 bar) Pressure Rating between probe tip and case
- Built-in Proximator® allows easier wiring by eliminating connectors and critical cable lengths
- Probe cable can be cut to length at the job site and wired to a standard terminal block
- Ample .5 inch (12.7 mm) range is ideal for most differential expansion applications
- Fully compatible with existing Bently Nevada Differential Expansion Monitors

Machine applications

Differential expansion measurement is best made *with two eddy current prox-*

imity probes mounted on a bracket inside the machine case. The probe bracket is attached to the case at the opposite end from the thrust bearing. Two probes are installed to provide redundancy for added reliability of the measurement, or they can be used to increase their measuring range when installed in complementary input or ramp differential expansion configurations. On turbine sets which have several separate casings, differential expansion measurements are usually made on each turbine.

Dual proximity probes observe a collar or ramp on the rotor and measure the rotor's axial position or distance from the machine case. The proximity probes send out a voltage signal proportional to distance which is then processed by a 3300 Differential Expansion Monitor. Redundant probes observing one side of a collar, complementary input probes observing both sides of a collar and two probes observing a ramp have all proven to be very successful monitoring arrangements. These sensor configurations are found on medium to large steam turbines used in power generation and on smaller mechanical drive steam turbines driving compressors.

When axial rotor growth is greater than casing growth, this is referred to as a *long rotor* condition. Rotor movement in the opposite direction is known as a

Expansion Transducer achieves outstanding accuracy



The 25mm Differential Expansion Transducer

short rotor condition. Excessive movement in either direction must be avoided to limit a turbine's differential expansion to allowable tolerances.

Typically, there are several operational scenarios which can produce substantial differential expansion changes:

1) Rapid loading of the turbine after a long period of operation at low load (typically known as "spinning reserve" capacity in a power system) causes significant *long rotor (positive)* movement.

2) Rapid load reduction after a long period of operation at high load causes significant *short rotor (negative)* movement. The worst situation may occur in a fault scenario where load rejection occurs as a result of sudden loss of condenser vacuum on power generation machines.

3) A stuck or jammed foot on the machine case can cause an excessive *long rotor* movement. The machine case must be allowed to move freely along its

skids during turbine warm-up to minimize abnormal differential expansion.

4) Boiler carry-over causes "wet steam" to cool a rotor, producing a *short rotor* movement. Carry-over occurs when the boiler water level rises too high and saturates the steam, causing a cooling effect on the rotor.

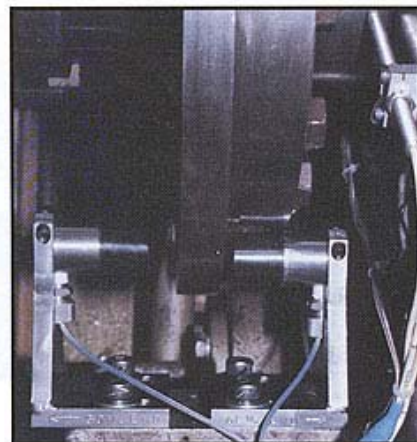
Improved accuracy

We recently re-examined the Differential Expansion measurement and concluded that substantial improvements could be made to the transducer. With today's advanced technology, we can reduce the size of the Proximity® and mold it into the 25mm probe tip assembly. Proximity® electronics can be incorporated into this probe in a quality manner due to the probe's larger size.

The probe tip and miniature Proximity® are sealed during the molding process and carefully mounted inside the probe case. This results in *greatly improved reliability and accuracy*.

The superior accuracy of the new 25mm proximity transducer is due to the elimination of separate external transducer components and their respective interchangeability errors. By incorporating matched system components (extension cable and Proximity®) into the proximity probe, we have eliminated interchangeability errors.

Another gain in accuracy is achieved by a new temperature compensation circuit within the probe that corrects the signal output over its entire temperature range. The result is a constant signal with excellent repeatability in virtually all machine conditions.



Complementary input configuration

Seals out moisture

The 25mm Differential Expansion Transducer is designed to be simple and reliable. Encapsulated electronics seals out moisture, while proven materials of construction resist corrosion.

Our goal is to make highly-accurate proximity transducers that resist harsh environments. This is important as the transducers are often mounted inside the machine and can be difficult to replace. In addition, the integrity of the entire monitoring and diagnostic system depends on accurate, repeatable signals from the transducers.

The 25mm Differential Expansion Transducer is part of a complete 3300 Turbine Supervisory Instrumentation package that is designed to increase safety and efficiency in your facility. For more information on the 25mm Differential Expansion Transducer, contact your nearest Bently Nevada sales or service representative. ■